EXHIBIT D

IN THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF OHIO
EASTERN DIVISION

Case No. 1:19-cv-1611-DCN

The Honorable Donald C. Nugent

Terves LLC

vs.

Yueyang Aerospace New Materials Co. Ltd.
et al.

Rebuttal Report of Lee A. Swanger, Ph.D., P.E.
Claim Construction: U.S. Patent 9,903,010 and U.S. Patent 10,329,653

May 4, 2020

I. Introduction

A. Background/scope of engagement

Attorneys for Terves LLC and Terves Inc. have retained me via my employer Exponent, Inc. to evaluate and, if required, rebut the opinions expressed by Dr. Dana Medlin in his "Declaration of Dr. Dana J. Medlin, Ph.D., P.E., FASM Addressing Proposed Claim Terms to be Construed and Proposed Constructions." Defendants have identified that certain claim terms require construction. While Dr. Medlin did not examine all of those terms raised by defendants, a subset of those terms examined by Dr. Medlin are as follows:

- intermetallic phase
- melting point temperature of said magnesium or magnesium alloy
- smaller average sized particles
- greater weight percent of said in situ formed galvanically active particles
- sufficient quantities in said galvanically-active intermetallic phases
- a portion of said additive material forming solid particles . . . and a portion of said additive material remaining unalloyed material

For each of these claim terms, Dr. Medlin concludes:

> "... it is my opinion that each of these claim terms, read in light of the patent's specification and prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of this invention . . ."

Succinctly, Dr. Medlin opines that these claim terms as used in U.S. Patent 9,903,010 (the '010 Patent) and U.S. Patent 10,329,653 (the '653 Patent) are indefinite. In this report, I analyze the arguments set forth by Dr. Medlin, and present my comments and opinions thereupon.

B. Qualifications

I am employed by Exponent, Inc. as a Principal Engineer, and Director of Exponent's Miami, Florida office. My background is in the area of both metallurgical engineering including physical metallurgy and mechanical engineering. I have a B.S. in Metallurgy, with

Highest Honors, from Case Western Reserve University, an M.S. in Materials Science and Engineering from Stanford University, and a Ph.D. in Materials Science and Engineering, also from Stanford University. I then joined The Ohio State University Department of Materials Science and Engineering as a Post-Doctoral Research Associate studying corrosion, in conjunction with Professor Mars Fontana and Professor Roger Staehle. I have served as an Adjunct Professor of Engineering, teaching metallurgical engineering, at both Cleveland State University and at the University of Miami. I am a Registered Professional Engineer in several states, including Ohio, in both metallurgical engineering and in mechanical engineering, and have been a member of ASM International (formerly the American Society for Metals) since 1968. As set forth in more detail in my curriculum vitae (Ex. A), I have substantial experience in the areas of metallurgical engineering, alloy design, electroplating, and corrosion engineering. Prior to joining Exponent, I was Director of Research and Development for the Engine Parts Division of Gould, Inc. in Cleveland, Ohio. While at Gould I was the sole inventor of U.S. Patent 4,333,215 in the metallurgical art, and assisted my attorney in the prosecution of that patent. One of my responsibilities at Gould was the management of its intellectual property portfolio, including monitoring progress on research and development projects and monitoring patent applications. I have been accepted as a testifying trial expert in intellectual property litigation in several Federal District Courts in various states.

C. Facts and Data Considered

A listing of the facts, documents and items considered is attached hereto (Ex. B)

D. Any Exhibits that may be used at hearing

I reserve the right to use as exhibits in support of my testimony any material referred to in this report and/or the exhibits thereto, and any demonstrative or summary exhibits explaining, illustrating or summarizing any of the opinions expressed in this report or the information contained in it, referenced by it, or reviewed in connection with it.

E. List of all publications authored in previous 10 years

A list of my publications is included in the resume attached (Ex. A)

F. A list of all other cases in which, during the previous 4 years, the witness testified as an expert at trial or by deposition

My list of sworn testimony is attached hereto (Ex. C)

G. Statement of compensation to be paid for the study and testimony in the case

I am a salaried employee of Exponent, Inc. My employer charges for my professional services at the rate of $575 per hour. Neither my employer nor I have any financial interest in the outcome of this matter.

II. Legal Standard for Claim Construction

I have been advised by attorneys for Terves that the following applies to claim construction in this matter and to Dr. Medlin's analysis:

Standard:

The Supreme Court held that a patent claim is indefinite if, when "read in light of the specification delineating the patent, and the prosecution history, [the claim] fail[s] to inform, with reasonable certainty, those skilled in the art about the scope of the invention." Nautilus, Inc. v. Biosig Instruments, Inc., 134 S.Ct. 2120, 2124, 189 L.Ed.2d 37 (2014).

"Reasonable certainty" does not require "absolute or mathematical precision." Biosig Instruments, Inc. v. Nautilus, Inc., 783 F.3d 1374, 1381 (Fed. Cir. 2015). The accused infringer has the burden of proving indefiniteness by clear and convincing evidence. Id. at 1377. See also BASF Corp. v. Johnson Matthey Inc., 875 F.3d 1360, 1365 (Fed. Cir. 2017)

"[A]n inventor need not explain every detail because a patent is read by those of skill in the art." Wellman, Inc. v. Eastman Chem. Co., 642 F.3d 1355, 1367 (Fed. Cir. 2011).

"The mere observation of information not 'recited' [in a patent] does not answer the question whether a person of ordinary skill in the art would need to be given the level and measurement information to understand, with reasonable certainty, whether a composition is 'effective to catalyze' the SCR (of NOx) or AMOx reactions." BASF Corp. v. Johnson Matthey Inc., 875 F.3d 1360, 1366 (Fed. Cir. 2017) (reversing indefiniteness for term "effective to catalyze" as that term does not need to be defined with any absolute or mathematical precision and fact that "x" can be numerous different responses does not make it indefinite).

A finding of indefiniteness based on a broad scope is legally incorrect: "breadth is not indefiniteness." SmithKline Beecham Corp. v. Apotex Corp., 403 F.3d 1331, 1341 (Fed. Cir. 2005) (internal brackets omitted). See also BASF Corp. v. Johnson Matthey Inc., 875 F.3d 1360, 1367 (Fed. Cir. 2017) (district court's finding of "a practically limitless number of materials" goes to broad claim scope and does not support conclusion of indefiniteness).

"Nothing inherent in the standard of 'reasonable certainty' precludes a relevant skilled artisan from understanding with reasonable certainty what compositions perform a particular function." BASF Corp. v. Johnson Matthey Inc., 875 F.3d 1360, 1366 (Fed. Cir. 2017).

The Federal Circuit has "long held" that nothing in the law precludes, for indefiniteness, "defining a particular claim term by its function." Hill-Rom Servs., Inc. v. Stryker Corp., 755 F.3d 1367, 1374–75 (Fed. Cir. 2014); see Cox Commc'ns, Inc. v. Sprint Commc'n Co. LP, 838 F.3d 1224, 1232 (Fed. Cir. 2016) (explaining that claims "are not per se indefinite merely because they contain functional language"), Microprocessor Enhancement Corp. v. Tex. Instruments Inc., 520 F.3d 1367, 1375 (Fed. Cir. 2008) (explaining that "apparatus claims are not necessarily indefinite for using functional language"); In re Swinehart, 439 F.2d 210, 212 (CCPA 1971) (ruling that "there is nothing intrinsically wrong with the use of such a technique in drafting patent claims").

Claim Construction

I understand that claim terms should be construed consistent with their ordinary meaning as would be understood by a person having ordinary skill in the art in the context of the patent, specification, and prosecution history and, to a lesser degree, extrinsic evidence, such as dictionaries. *Phillips v. AWH Corp*., 415 F.3d 1303, 1321 (Fed. Cir. 2005).

III. Summary of Opinions

The terms in the '010 Patent and the '653 patent are well known in the metallurgical field (including corrosion engineering and electroplating) and in the field of chemistry, and I did not see any evidence suggesting that the patent owner deviated from the ordinary meaning of those terms in the claims.

I also find the opinions from Dr. Dana J. Medlin, that certain claimed terms cannot be construed because are indefinite, to be incorrect. These are terms that are used in metallurgy, corrosion engineering and chemistry that persons of ordinary skill would understand, including galvanic activity (the basis for all batteries and for galvanized steel, and for some basic forms of corrosion), phase equilibria as promulgated via binary phase diagrams, such as those for Cu-Mg and Mg-Ni, which are attached as Exhibit D, melting and freezing as one of the basic phase transformations, and the formation of new phases which are compounds of two elements.

IV. Person of Ordinary Skill in the Art (POSITA) at the Time of the Invention

The '010 Patent and the '653 Patent both derive from provisional application No. 61/981,425, filed on April 18, 2014. A person of ordinary skill at the time of the invention (April 18, 2014) would

have at least a Bachelor's Degree in chemistry, material science and engineering, metallurgy, or a related scientific degree, and at least five years experience in working with dissolvable metallic-based materials.

The specific experience with dissolvable metallic-based materials is significant because the majority of engineers and scientists working in chemistry metallurgy or corrosion are focused on two different aspects of electrochemistry, either preventing or minimizing corrosion, or electroplating of metals, wherein the dissolution of the anode is assumed, and the effort is all directed toward effective and efficient deposition of electroplated material on the cathode.

The '010 Patent and the '653 Patent are directed to those already skilled in the art of producing dissolvable metallic magnesium-based materials. Based on my own education, training, and experience in metallurgy, materials science and engineering, chemistry, corrosion, and electroplating (including studying anodic dissolution for efficient electroplating of bearings and production of copper foil for printed circuit board by electrodeposition), I am familiar with the training and experience required to be a POSITA in this particular art, and I was a POSITA well prior to 2014.

V. Background of the '010 Patent and the '653 Patent

The present invention is a method for producing novel magnesium composites (the '010 Patent) and the dissolvable magnesium composite articles (the '653 Patent) where the composite elemental composition and microstructure can be controlled to achieve desirable dissolution rates under specified environmental conditions, along with beneficial mechanical properties.

Metallic additives having specific ranges of elemental composition are introduced into the magnesium or magnesium alloy during the melting process at specific temperatures. The addition of the additive results in the development of secondary phase particles during cooling to room temperature, which remain in the magnesium composite at temperatures between room temperature and at least 90° C.

These secondary phase particles result either through in-situ diffusion-driven formation of intermetallic phase particles and/or particles of unreacted additive material that persist when the alloy is cooled to room temperature. These secondary phase particles are designed and optimized to have an elemental composition that results in the formation of "galvanically active intermetallics" that induce controlled accelerated corrosion at elevated temperatures in certain brine solutions of an otherwise corrosion resistance magnesium alloy.

Optimization of the specialized casting process for unreacted additive particles requires adding additive to the magnesium alloy in a temperature range above the melting temperature of the magnesium alloy but below the melting temperature of the additive material. In effect, the result is that the additive material is added as a solid, remains as a solid and does not melt and become homogenous with the magnesium alloy.

Under optimized conditions, some additives can undergo solid/liquid diffusion to form intermetallic compounds that result in mechanical property optimization and dissolution rate control. The resulting magnesium composite is the combination of the magnesium alloy plus the additive material.

The specifications of the ‘010 and ‘653 Patents teach that certain additive elements, including copper, nickel, iron, cobalt, titanium, and silicon, will create galvanically active intermetallic phases or galvanically active intermetallic particles under melting and alloying conditions taught in the specification.

Galvanically active means that the particles in intermetallic phases are sufficiently noble or cathodic to the surrounding magnesium alloy such that galvanic corrosion will occur when the magnesium composite is subject to an aqueous electrolyte under certain conditions of concentration of ionic species and temperature.

Typical galvanic series demonstrate that the additives copper, nickel, iron, titanium and cobalt will be cathodic with respect to magnesium and magnesium alloys. Typical alloying elements include zinc, aluminum, zirconium, bismuth, and certain rare earth elements added to the magnesium alloy for grain refinement or increases in tensile strength and/or ductility.

In addition, the paper of Hawke et al. (SAE 930751, March 1993), which references Hanawalt’s work on “Corrosion Studies of Magnesium and Its Alloy”, presents the quantitative electrochemical potentials of Mg_2Cu and Mg_2Ni, which are sufficiently noble or cathodic to that of magnesium alloys to categorize these intermetallic phases as galvanically active thereby promoting corrosion in magnesium composites. These intermetallic phases, Mg_2Cu and Mg_2Ni, are two of the galvanically active intermetallic phases disclosed in the ‘653 Patent.

The inventions of the ‘010 and ‘653 Patents include claim limitations as ranges of chemical composition of the claimed magnesium composites, including the additives which will create galvanically active intermetallic phases via precipitation, as well as the alloying elements, if any, that will develop desired mechanical properties in the magnesium composite. The claims also

claim the range of dissolution rates that the claimed magnesium composite will exhibit under claimed corroding environmental conditions.

VI. Analysis of Dr. Medlin's Opinions

a. Intermetallic phase

Dr. Medlin states that "A POSITA [person of skill in the art] would understand that intermetallic phases or compounds have a fixed stoichiometry . . ." This is incorrect on its face. The binary phase diagrams for two of the examples cited in the '010 and '653 Patents, attached hereto as Exhibit D, each show an intermetallic phase with a range of composition, not a fixed stoichiometry, namely $CuMg_2$ and Mg_2Ni. A POSITA would understand that more than one intermetallic phase is possible, and that intermetallic phases can occur at fixed stoichiometries (represented by a vertical line on a phase diagram) or that they can occur within a range of compositions (represented by a vertical area with a non-zero horizontal range on a phase diagram). Dr. Medlin goes on to state " . . . the term 'intermetallic phase' is undefined because '010 and '653 claims, specifications, and prosecution histories do not define the stoichiometries for the various 'intermetallic phases.' " Dr. Medlin's statement is incorrect as it ignores the many references in the specifications of both Patents to the intermetallic phases $CuMg_2$ and Mg_2Ni, for example.

Dr. Medlin proceeds to criticize the standard practice of using the subscript "x" to refer to a multiplicity of possible ratios of one component of an intermetallic phase to the other component. Dr. Medlin's opinion is based on the mistaken belief that breadth of "x" makes it indefinite, which is incorrect. Instead, a POSITA would be familiar with this standard nomenclature, and would naturally refer to a binary phase diagram to determine the small finite allowable values of the subscript "x". In practice, "x" is either an integer (1, 2, 3, etc.) or the reciprocal of an integer (1/2, 1/3, etc.) or a ratio of integers (2/3, 3/4, etc.)

As I pointed out in my report in this matter for purposes of Preliminary Injunction, dated April 28, 2020:

> In each of the seven Ecometal magnesium composite grades evaluated, the concentration of copper and/or nickel is low enough that the only intermetallic phase that will form is either $CuMg_2$ or Mg_2Ni or a blend thereof, which Hawke et al. has shown to be galvanically active with respect to magnesium and magnesium alloys. The binary phase diagrams for the Cu-Mg system and

> the Mg-Ni system that demonstrate that conclusion are attached hereto (Ex. E). [Ex. D of this report]

Indeed, for each of the additive materials claimed in the ‘010 and ‘653 Patents, i.e., copper, nickel, cobalt, iron, titanium and silicon, within the range of additive material in the claimed magnesium composites, only one galvanically active phase is thermodynamically possible to achieve.

Additionally, Dr. Medlin claims that it is “ . . . unclear as to whether the “galvanically-active intermetallic particle” is formed by reactions between the magnesium and a secondary metal, an alloy and a secondary metal, or the magnesium alloy and the secondary metal.” He uses as an example claim 25 of the ‘653 Patent:

> “A dissolvable magnesium alloy composite for use in a ball or other tool component in a well drilling or completion operation, said dissolvable magnesium alloy composite comprising at least 85 wt. % magnesium; one or more metals selected from the group consisting of 0.5-10 wt. % aluminum, 0.05-6 wt.% zinc, 0.01-3 wt.% zirconium, and 0.15-2 wt. % manganese; and about 0.05-45 wt. % of a secondary metal to form a galvanically-active intermetallic particle that promotes corrosion of said dissolvable magnesium alloy composite, said secondary metal including one or more metals selected from the group consisting of copper, nickel, cobalt, titanium and iron, said magnesium alloy composite has a dissolution rate of at least 5 mg/cm2 /hr. in 3 wt. % KCI water mixture at 90° C.”

From Section II above, “[n]othing inherent in the standard of “reasonable certainty” precludes a relevant skilled artisan from understanding with reasonable certainty what compositions perform a particular function.” BASF Corp. v. Johnson Matthey Inc., 875 F.3d 1360, 1366 (Fed. Cir. 2017). Therefore, a POSITA would understand that within the ranges of composition given for the constituents of the magnesium composite, thermodynamics would prescribe what galvanically-active intermetallic particle would be formed.

Furthermore, as a basic tenant of the English language, there is a semi-colon between “0.15-2 wt. % manganese” and the next phrase “and about 0.05-45 wt. % of a secondary metal to form a galvanically-active intermetallic particle”. This clearly indicates that a new claim limitation is being introduced, and that the secondary metal, subsequently limited in the claim to the elements “copper, nickel, cobalt, titanium and iron” is the component of the galvanically-active intermetallic particle.

I have consulted reference books and textbooks representative of those that a POSITA would have used during that person's education and professional practice, to confirm the normal understanding POSITA would have regarding some of the disputed claim terms. Excerpts from those books are presented in Exhibit E, attached. The portion of Exhibit E related to the definition of "intermetallic phase" and the related concept of intermetallic compound are in complete support of my opinion stated in the following paragraph.

It is my opinion that a POSITA would understand the claim term "intermetallic phase" as normally used in metallurgy, materials science and engineering, and in chemistry. This term is not vague or indefinite and no construction is needed. Terves' proposed construction, "Compound that has two or more metals" is consistent with the binary phase diagrams that show the intrinsic thermodynamic restrictions on the intermetallic phases.

b. Melting [point] temperature of said magnesium or magnesium alloy

Dr. Medlin is incorrect in stating that this term appears in claim 1 and claim 15 of the '010 Patent. It does not appear in those two claims. Those two claims do reference a "solidus temperature of magnesium or magnesium alloy" which requires no claim construction.

Claims 10, 11, 24 and 25 of the '010 Patent only reference "a melting temperature of said magnesium composite", not magnesium or a magnesium alloy. That is not the claim term in dispute.

Claims 20, 28, 29 and 37 through 42 of the '010 Patent describe "heating [magnesium or] magnesium alloy to a point above its solidus temperature" and then introducing an additive material. The additive material is further limited to one having a melting point temperature either greater than, or 100°C greater "than a melting temperature of said [magnesium or] magnesium alloy". Note that the claims do not say "than **the** melting temperature . . .". A POSITA would understand that since the key temperature for the magnesium or magnesium alloy is the solidus, that the solidus or the temperature at which liquid is formed, is the correct selection for **a** "melting temperature of said magnesium or magnesium alloy."

I have consulted reference books and textbooks representative of those that a POSITA would have used during that person's education and professional practice, to confirm the normal understanding POSITA would have regarding some of the disputed claim terms. Excerpts from those books are presented in Exhibit E, attached. The portion of Exhibit E related to the definition of "melting point" is in complete support of my opinion that this claim term is not vague or indefinite, this claim term is understood as having its normal meaning in the art, and no claim construction is required.

A POSITA would also know, likely without even looking them up, that the melting points of the limited set of additive materials, copper, nickel, cobalt, iron, titanium and silicon all have melting temperatures at least 400°C greater than the melting point of pure magnesium, and at least 400°C greater than any liquidus of any magnesium alloy claimed in the ‘010 and ‘653 Patents, so this claim term is actually moot, and no construction is required.

c. Smaller average sized particles

Dr. Medlin asserts that this claim term “has no particular meaning to a POSITA without proper context.” He is incorrect, because the context is in the specifications of the ‘010 and ‘653 Patents. As explained in the specification, the net area of the galvanically-active particles is a controlling factor in the rate of dissolution of the claimed magnesium composites. This discussion reminds a POSITA of what the POSITA already knows, that for a given mass of a phase, the net surface area of a phase increases as the average particle size decreases and the number of particles goes up. This phrase is not a claim limitation, it is merely an exemplary explanation for how to adjust the dissolution rate to fit the needs of the POSITA who may wish to practice the patented claims.

The discussion about smaller average sized particles is a relative term, that is the particles are smaller than another set of particles. There is no need to specify quantitatively what the numerical value of “smaller” is, it is merely relative. This claim term is not vague or indefinite.

I have consulted reference books and textbooks representative of those that a POSITA would have used during that person’s education and professional practice, to confirm the normal understanding POSITA would have regarding some of the disputed claim terms. Excerpts from those books are presented in Exhibit E, attached. A portion of Exhibit E describes the concept of “quantitative metallography”, which has been used for many decades to measure characteristics of phases in microstructures of metal alloys, including particle size, volume concentration, and surface-area-to-volume ratios of particles. This demonstrates that a POSITA would be knowledgeable about the normal meaning of “smaller average sized particles” in complete support of my opinion that this claim term is not vague or indefinite. This claim term would be understood by a POSITA as having its normal meaning in the art, and no claim construction is required.

Since a POSITA would understand this explanatory language as having its normal meaning in the art of dissolvable magnesium composites, no construction is necessary.

d. Greater weight percent of said in situ formed galvanically-active particles

Analogous to the discussion of "smaller average sized particles" this phrase is a reminder of the relative ratio of mass of a phase to its net surface area, given a particular average size of the phase particles. Since the term is relative, no quantitative starting point is needed for a POSITA to be reminded of what that person already knows, namely that adding more galvanically-active particles of a given average size will increase the net area of those particles and thus increase the rate of dissolution of the magnesium alloy. This claim term is not vague or indefinite. No construction is necessary.

e. Sufficient quantities in said galvanically-active intermetallic phases

Sufficient means "enough" to accomplish the required result, and is defined within claims 49 and 73 of the '653 Patent in which this claim term appears as sufficient or enough " to obtain a composition and morphology of said galvanically-active intermetallic phases such that a galvanic corrosion rate along said galvanically-active intermetallic phases causes said magnesium composite to have a dissolution rate of at least at least (sic) 5 mg/cm^2/hr. in 3 wt.% KCl water mixture at 90° C." This requirement within the claims themselves provides the context that Dr. Medlin asserts is missing.

This claim term is not indefinite. A finding of indefiniteness based on a broad scope is legally incorrect: "breadth is not indefiniteness." SmithKline Beecham Corp. v. Apotex Corp., 403 F.3d 1331, 1341 (Fed. Cir. 2005) (internal brackets omitted). See also BASF Corp. v. Johnson Matthey Inc., 875 F.3d 1360, 1367 (Fed. Cir. 2017) (district court's finding of "a practically limitless number of materials" goes to broad claim scope and does not support conclusion of indefiniteness).

A POSITA would understand from the required range of dissolution rates, how the sufficient quantity of galvanically-active intermetallic phases can be determined with a small number of tests, under a design-of-experiments protocol, without undue experimentation. This claim term is not indefinite or vague and no construction is required.

f. A portion of said additive material

The context of this claim term is given in the specifications of the '010 and '653 Patents, and, for example, in claim 20 of the of the '010 Patent. The process described tells a POSTIA to introduce the additive material as particles of a specific size range, and as pure metals selected from the list of copper, nickel, cobalt, titanium, and iron. The additive metal will dissolve in a time-dependent manner, well-known to a POSITA, and the dissolution of the additive metal into the magnesium or magnesium alloy can be stopped at an intermediate step by following the claim procedure of "cooling said mixture to form said magnesium composite." The resulting composite will thus contain unalloyed additive

material as well as precipitates formed from the liquid solution of the additive metal dissolved in the liquid magnesium of magnesium alloy.

The final magnesium composite with thus have a portion (or a fraction, or "some") of the additive metal in unalloyed form, and a portion (or a fraction, or "some") of the additive metal in a galvanically-active intermetallic phase. The claim limitation is that 100% of the additive material will NOT be in unalloyed particles, and 100% of the additive material will NOT be in a galvanically-active intermetallic phase. This portioning of an additive material with a melting point above a melting temperature of the liquid into which it is being introduced is well-known to a POSITA in its normal meaning, and therefor this claim term is not vague or indefinite, and no construction is required. In the alternative, a portion of said additive material means "some, but not all."

VII. Additional analysis

In studying the declaration of Dr. Medlin, I find that he frequently failed to consider the subset of claim terms that he addressed in the context of the claims, or in the context of the specifications of the '010 and '653 Patents. As I have pointed out in this report, the context he asserted was missing was within the patents themselves.

Dr. Medlin's indefiniteness opinions apparently are based solely on Dr. Medlin's beliefs. His report does not identify any scientific literature he cites or relies upon to support his opinions. In my opinion Dr. Medlin underestimates the knowledge of a POSITA under even his own less restrictive definition. The concepts of chemistry, thermodynamics and phase equilibria that are compiled in binary phase diagrams are the heart and soul of what metallurgists and chemists learn, understand, and apply.

The literature which Dr. Medlin's report ignores readily shows the knowledge of these terms and how to determine the existence of an intermetallic phase, a melting point, a particle size, weight percentage, sufficient quantities, or a portion of additive material. Despite significant amounts of literature in metallurgy spanning decades of research in the field on these concepts, Dr. Medlin's failure to cite to any scientific literature showing any indefiniteness to determine an intermetallic phase, a melting point, a particle size, weight percentage, sufficient quantities, or a portion of additive material, for example, highlights how Dr. Medlin's opinions are his own and not supported by any scientific methodology or research in the field.

VIII. Methodology

The methodology I used to arrive at my opinions is accepted in the scientific community and is appropriate for reaching scientifically reliable conclusions such as those stated and discussed in this report. This methodology includes the following:

(1) informing myself regarding relevant aspects of patent law through discussions with counsel for Terves

(2) identifying a person of skill in the art, based on my own experience with metallurgy, materials science, chemistry, corrosion, electroplating, and patent litigation

(3) reading the subject ‘010 and ‘653 Patents to understand the claims in terms of the specifications

(4) studying the declaration of Dr. Medlin to understand his methodology and conclusions

(5) applying my education, training, knowledge of the metallurgy field and research, and experience to analyze the issues I was asked to consider.

IX. Supplementation

While the opinions set forth in this report are complete, I reserve the right to supplement this report and any of the opinions expressed herein, should I receive additional information or evidence that is relevant to those opinions between now and the time that I testify at the preliminary injunction hearing. Moreover, I reserve the right to serve one or more additional expert reports in this litigation if requested to do so, and I reserve the right to supplement the opinions set forth herein as part of such additional expert reports in order to account for additional information or evidence that is learned or developed before any such additional report is prepared.

Respectfully submitted,

Lee A. Swanger, Ph.D., P.E.
Principal Engineer, Exponent, Inc.
May 4, 2020

Exhibit A

Exponent®
Engineering & Scientific Consulting

Lee A. Swanger, Ph.D., P.E.

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Professional Profile

Dr. Swanger is the Director of Exponent's Miami, Florida, office. His consulting work centers on the application of the principles of mechanical engineering, metallurgical and materials engineering, thermodynamics, and design engineering to issues related to incidents involving performance of engineered products and systems, accident reconstruction, and failure or fracture of system components. He also consults on issues of patent infringement and patent validity in the mechanical and materials arts. More specifically, Dr. Swanger's experience includes the analysis of machinery dynamics and kinetics as exemplified by internal combustion engines of both piston and turbine configuration, as well as related compressor designs. His materials and metallurgical experience includes alloy applications, heat treatment, electrochemistry and corrosion, welding and brazing, and materials testing. He applies his combined expertise in both mechanical engineering and materials/metallurgical engineering to issues of fatigue and fracture, and mechanical joining via threaded fasteners.

Applications of these disciplines include systems in nuclear and fossil power plants, components of transportation systems on land, sea, and air, industrial manufacturing processes, components of commercial and residential buildings, materials used in the petroleum and chemical industries, machinery and processes for vapor degreasing and dry cleaning, and consumer products including sports equipment and kitchen appliances.

Dr. Swanger has a particular interest in engine design and performance, with an emphasis on combustion, operational stresses, lubrication and bearing design and performance. He received a U.S. Patent for his engine bearing material and fabrication process.

Academic Credentials & Professional Honors

Ph.D., Materials Science and Engineering, Stanford University, *with distinction*, 1972

M.B.A., Marketing/Finance, Cleveland State University, 1982

M.S., Materials Science and Engineering, Stanford University, 1969

B.S., Metallurgy, Case Institute of Technology, *with highest honors*, 1968

Hertz Foundation Graduate Fellowship, 1970-1972

Member, Board of Directors of the Fannie and John Hertz Foundation

Licenses and Certifications

Licensed Professional Engineer, Alabama, #29848-E

Licensed Professional Mechanical Engineer, California, #M23275

Licensed Professional Engineer, Florida, #37207

Licensed Professional Engineer, Georgia, #PE036205

Licensed Metallurgical Engineer, Louisiana, #34064

Licensed Professional Engineer, Mississippi, #25349

Licensed Professional Engineer, New York, #93691

Licensed Professional Metallurgical Engineer, Ohio, #44024

Licensed Professional Engineer, Virginia, #15492

Licensed Mechanical Engineer, Wyoming, #11899

Prior Experience

Adjunct Professor, Mechanical Engineering Department, University of Miami, 1999-2008

Director of Research and Development, Engine Parts Division, Imperial Clevite, 1979-1983

Lecturer, Mechanical Engineering Department, Cleveland State University, 1978-1982

Project Manager, Gould Labs for Materials Research, Gould Inc., 1975-1979

Associate Sr. Research Metallurgist, General Motors Research Labs, 1973-1975

Patents

Patent 4,333,215: Bearing Material and Method of Making, issued June 8, 1982.

Publications

Rogers G, Swanger L, Wells C. The Role of testing programs in verifying structural integrity of medium speed diesel generator components. Institute for Electrical and Electronics Engineers Transaction on Nuclear Science 1985; NS-32(1), February.

Swanger L. Inhomogeneous thermodynamics and spinodal decomposition. Ph.D. Dissertation, Stanford University, August 1972.

Swanger L, Rhines W. On the necessary conditions for homogeneous nucleation of gas bubbles in liquids. Journal of Crystal Growth 1972; 12:323-326.

Barnett D, Swanger L. The elastic energy of a straight dislocation in an infinite anistropic elastic medium. Physica Status Solidi (B) 1971; 48:419-428, 1971.

Swanger L, Cooper A, Gupta P. Computer simulation of one-dimensional spinodal decomposition. Acta

Metallurgica 1970; 18:9-14.

Presentations

Swanger L. Expert witnesses in patent infringement litigation. Presented to Cleveland Ad-Hoc Patent Litigators Council, Cleveland, OH, December 2004.

Swanger L. Early assessment of product liability claims, the role of the engineering consultant. Presented to TriMas Litigation Conference, Detroit, MI, June 2002.

Swanger L. How to solve your bearings' problems. Presented at Joint Emergency Diesel Generator Owners Group Conference, Chicago, IL, June 1997.

Swanger L, Vogler M, Rau S. Investigation of the reliability of solid aluminum main bearings in emergency diesel generators. 9th International Conference on Structural Mechanics in Reactor Technology, Volume D, Lausanne, Switzerland, August 1987.

Johnston P, Shusto L, Swanger L. Analysis of diesel engine crankshaft torsional vibrations. 9th International Conference on Structural Mechanics in Reactor Technology, Volume D, Lausanne, Switzerland, August 1987.

Swanger L. Advanced techniques of accident investigation. Presented at Occupational Safety and Health Administration Training Institute, Des Plaines, IL, March, June, and September 1986.

Swanger L, Harris D, Johnston P, Derbalian G. Advanced methods for diesel component life prediction. Society for Automotive Engineers Paper 860885, Marine Propulsion Technology Conference, Washington, DC, May 1986.

McCarthy R, McCarthy G, Swanger L. Reliability and service life of steel truck wheels. Annual Reliability and Maintainability Symposium, Las Vegas, NV, January 1986.

Rogers G, Wells C, Swanger L. Design analysis of emergency diesel generator components to establish reliability under operating conditions. 8th International Conference on Structural Mechanics in Reactor Technology, Brussels, Belgium, August 1985.

Swanger L. Bearing materials update. Presented to Society of Automotive Engineers Off-Highway Conference, Milwaukee, WI, September 1981.

Swanger L. Developments in bearings and pistons. Presented at O Motor no Futuro (The Engine of the Future), Sao Paulo, Brazil, September 1980.

Swanger L. Selection of crankshaft materials for optimum bearing performance. Presented to Society of Manufacturing Engineers Conference, CM80-392, Los Angeles, CA, June 1980.

Swanger L. Heavy duty bearings: Materials and process. Presented at Carnegie-Mellon University, Pittsburgh, PA, March 1980.

Reports

Swanger L. Rule 26 Report of Lee A. Swanger In the Matter of Darrell W. Hartman v. Caterpillar Inc., et. al., May 28, 2010.

Swanger L. Rule 26 Report of Lee A. Swanger In the Matter of Innovative Fuel Products, LLC vs. BP Products North America Inc., December 23, 2010.

Swanger L. Report of Lee A. Swanger In the Matter of Questar Gas Management Co. v. Waukesha and Stewart & Stevenson, March 13, 2009.

Swanger L. Expert Report of Lee A. Swanger, Ph.D. P.E. Regarding Invalidity of U.S. Patent No. 6,979,117 and U.S. Patent No. 7, 281,842, K-TEC, Inc. vs. Vita-Mix Corporation, January 15, 2010.

Swanger L. Expert Report on Patent Infringement Pursuant to Rule 26(A)(2)(B) by Lee A. Swanger, Ph.D., P.E., Vita-Mix Corporation vs. Basic Holding, Inc., Focus Products Group, LLC, Focus Electrics, LLC, and West Bend Housewares, LLC, December 17, 2007.

Swanger L. Expert Report on Rebuttal of "Expert Report of Majid Rashidi, Ph.D., P.E." Dec. 17, 2007 Regarding the Invalidity of U.S. Patent No. 5,302,021 and "Expert Report of Thomas F. Smegal, Jr." Dec. 13, 2007 Regarding Inequitable Conduct During Prosecution of U. S. Patent No. 5,302,021, Pursuant To Rule 26(A)(2)(B) by Lee A. Swanger, Ph.D., P.E., Vita-Mix Corporation vs. Basic Holding, Inc. f/k/a Back to Basics Products, Inc., Focus Products Group, LLC, Focus Electrics, LLC, and West Bend Housewares, LLC, January 7, 2008.

Swanger L. Rule 26 Report of Lee A. Swanger In the Matter of Horton, Inc. v. NSK Corporation, Inc., American Arbitration Association Case No. 65 181 Y 00320 05, October 9, 2006.

Swanger L. Report of Lee A. Swanger In the Matter of Lloyd Cunningham v. Henry Repeating Arms Co. et.al. pursuant to Federal Rule 26, July 28, 2006.

Swanger L. Expert Report on Patent Infringement Pursuant To Rule 26(A)(2)(B) by Lee A. Swanger, Ph.D., P.E., Fellowes, Inc. vs. Michilin Prosperity Company Ltd. & Intek America, Inc., January 26, 2007.

Swanger L. Expert Report on Rebuttalof January 26, 2007 "Expert Report of Elliot L. Stern, Ph.D., On The Invalidity of U.S. Patent Nos. 6,260,780 And 7,040,559" Pursuant To Rule 26(A)(2)(B) by Lee A. Swanger, Ph.D., P.E., Fellowes, Inc. vs. Michilin Prosperity Company Ltd. & Intek America, Inc., February 26, 2007.

Swanger L. Report of Lee A. Swanger Responsive to Judge Tarnow's Order of June 5, 2006, James W. Jaikins v. Caterpillar, Inc., Case No. 04-73404, December 3, 2006.

Swanger L. Bearing and Valve Investigation, Wartsila 18V46 - DG-02, Central Electrica Talnique, El Salvador, Prepared for: Inversiones Energéticas S.A. de C.V., September 22, 2009.

Swanger L. Hydrodynamic Crankshaft Bearings in Nordberg Emergency Diesel Generators, Prepared for Engineering Staff, Brunswick Nuclear Plant, Progress Energy, Southport, NC, February 17, 2011.

Swanger L. Rule 26 Report of Lee A. Swanger In the Matter of Douglas P. DeMasi v. United States of America, Case No. 3:09-cv-868-J-32JRK, October 14, 2010.

Swanger L. Response to Expert Report of Michael Thuma Pursuant to Rule 26(A)(2)(B) By Lee A. Swanger, Ph.D., P.E., Sunbeam Products, Inc. d/b/a Jarden Consumer Solutions vs. Homeland Housewares, LLC, et al., Case No. 3:09-CV-00791 REP, October 18, 2010.

Swanger L, McDaniel D. Nordberg ductile iron piston evaluation. Prepared for Progress Energy Brunswick Nuclear Station, January 5, 2006.

Swanger L. Report of Lee A. Swanger, Ph.D., P.E. In the Matter of Verve L.L.C. v Crane Cams, et. al. Reference U.S. Patent 4,850,315, January 24, 2005.

Swanger L. Report of Lee A. Swanger In the Matter of Vine Street, L.L.C. v. James R. Keeling et. al. Rule 26 report regarding Perchloroethylene Dry Cleaning machine function, Eastern District of Texas,

September 10, 2004.

Swanger L. Declaration of Lee A. Swanger, Ph.D., P.E. re: U.S. Patent 6,071,062. PODS, Inc. v. Porta Stor, Inc. et. al., September 9, 2004.

Swanger L. Declaration of Lee A. Swanger, Ph.D., P.E. in Opposition to Plaintiffs' Motion for Preliminary Injunction. Honeywell International Inc., et. al. v. ABB Inc., et. al., reference U.S. Patent 5,193,989, May 19, 2003.

Swanger L. Report of Lee A. Swanger, Ph.D., P.E. In the Matter of Air Turbine Technology v. Atlas Copco. Reference U.S. Patent 5,439,346, November 21, 2002.

Swanger L. Report of Lee A. Swanger, Ph.D., P.E. In the Matter of Marshalltown Trowel v. Lowe's re U.S. Patent 5,615,445. March 20, 2001.

Swanger L. Declaration of Lee A. Swanger, Ph.D., P.E. In the Matter of Monte J. Solazzi, et. al. v. Premier Lab Supply, Inc. et. al. Reference U.S. Patents 5,451,375 and 5.630,989, July 20, 2000.

Swanger L, Davy R, Eberly P, Waters L. Teledyne continental camshaft and lifter performance: The influence of lubricating oil on surface conditions. Technical Report to Special Masters in Gross v. Mobil, November 1996.

Johnston P, Shusto L, Swanger L. Evaluation of diesel generator Number 1 at Brunswick Nuclear Plant. Failure Analysis Associates, Inc., Technical Report, January 1993.

Swanger L. Investigation of repeated Number 5 main bearing degradation by flashing, Fairbanks Morse opposed piston auxiliary diesel on the Emory S. Land. Failure Analysis Associates, Inc., Technical Report, January 1992.

Scheibe R, Kadlec R, Swanger L, Littmann W, Clark R, Johnston P, Hayes D. Generator Bearing condition assessment: Unit DG-1, WPPSS WNP-2. Failure Analysis Associates, Inc., Technical Report, June 1991.

Swanger L, Mercaldi D, Bisbee L, Booth A, Vetter J. DC Motor Control Center 2PB-1 Fire at Fermi II Nuclear Plant. Failure Analysis Associates, Inc., Technical Report, March 1987.

Swanger L, Webb W, Bisbee, L. Failure Investigation of North Hot Reheat Line, Detroit Edison Monroe Unit #1. Failure Analysis Associates, Inc., Technical Report, September 1986.

Swanger L, Vogler M. Investigation of surface scoring of main bearings: Fairbanks Morse 38TD8-1/8 diesels at Fermi II Power Plant. Failure Analysis Associates, Inc., Technical Report, June 1986.

Swanger L. Design review of connecting rod bearing shells for Transamerica Delaval Enterprise Engines. Failure Analysis Associates, Inc., Technical Report, March 1984.

Swanger L, Bisbee L, Webb W. Evaluation of piston and bearing from the Baltimore Gas and Electric Hunt Valley Inn cogeneration system. Failure Analysis Associates, Inc., Technical Report, June 1992.

Swanger L. Review of performance problems, Occidental Chemical M/V Julius Hammer and M/V Frances Hammer, Colt-Pielstick, PC 2.5 diesel engines. Failure Analysis Associates Report, April 1986.

Exhibit B

Exhibit B: Documents and Items Considered

Complaint, Case No. 1:19-cv-1611-DCN

U.S. Patent 9,903,010

U.S. Patent 10,329,653

Protective Order, Case No. 1:19-cv-1611-DCN

Ecometal answers to Interrogatories

Ecometal and Yuan Preliminary Claim Constructions and Evidence

Terves' Preliminary Claim Constructions and Evidence

Declaration of Dr. Dana J. Medlin, Ph.D., P.E., FASM Addressing Proposed Claim Terms to be Construed and Proposed Constructions

Declaration of Andrew Sherman

Hawke et al., "Corrosion Properties of New Magnesium Alloys" SAE International Paper 930751 (1993)

Hanawalt et al., "Corrosion Studies of Magnesium and its Alloys" AIME Metals Technology, Technical Paper 1353 (1941)

Zhang et al., "Effect of Boron on the Grain Refinement and Mechanical Properties of as-Cast Mg Alloy AM50" Materials, (2019, 12,1100)

ASTM G31: "Standard Practice for Laboratory Immersion Corrosion Testing of Metals"

ASM Metals Handbook (1948)

ASM Metals Handbook, Tenth Edition, Volume 3 "Alloy Phase Diagrams" (1993)

ASM Metals Handbook, Desk Edition (1985)

Magnesium composite billets from Ecometal:
AJM006, AJM010, AJM 012, AJM016, AJM017, AJM018, AJM023,
MD-CAST, MM3, SD-CHST

Magnesium composite billets from Terves:
TAX100E-1, TAX100E-2, TAX100E-3, TAX HDD-1, TAX HDD-2

Cottrell, A..H., Theoretical Structural Metallurgy (1965)

Rhines, F. N., Phase Diagrams in Metallurgy, Their Development and Application (1956)

Smith, W. F. et al., Foundations of Material Science and Engineering (2006)

Henkel, D. et al., Structure and Properties of Engineering Materials, Fifth Edition (2002)

Callister, W. D., Material Science and Engineering, An Introduction, Sixth Edition (2003)

McGraw-Hill Dictionary of Scientific and Technical Terms, Third Edition (1984)

Wulff, J., The Structure and Properties of Materials, Volumes 1 and 2, (1964)

Swalin, R. A., Thermodynamics of Solids, (1962)

Darken, L. S., Physical Chemistry of Metals (1953)

Reed-Hill, R. E., Physical Metallurgy Principles, Second Edition (1973)

Exhibit C

CASE #	LITIGANTS	SUBJECT OF TESTIMONY	P or D	COUNSEL	JURISDICTION	VENUE	DATE OF TESTIMONY
CACE 12-026562 (04)	Gonzalez TaoTao USA	Mechanical Engineering	D	Hyram Montero Lynn Gambino	Circuit Court 17th Judicial Circuit	Broward County Florida	1/7/2015
CA 2:14cv189	Kettler Intl. Starbucks Corp.	Mechanical Engineering	D	Kelly Cox	US District Court Eastern District	David Gettings Virginia	3/20/2015
2:14-cv-12488-GER-MJH	Weber Manufacturing Plasan Carbon Comp.	Mechanical Engineering	P	Doron Yitzchaki Stephen Dunn	US District Court Eastern District	So. Division Michigan	4/17/2015
14-60528-CV-JIC	Transatlantic Lines Portus Stevedoring	Mechanical and Metallurgical Eng.	P	Patrick Novak Jomathan Cooper	US District Court Southern District	Ft. Lauderdale Div. Florida	5/27/2015
14-12705-CA-01	Zoila Cabrera Presidente Supermarket	Mechanical Engineering	D	Greg Ward Ron Pena	Circuit Court 11th Judicial Circuit	Miami Dade County Florida	
14-2-27732-6 KNT	Fire Insurance Exch/ a/s/o Adams Watts Regulator	Materials Engineering	D	J. Jason Marquoit John Knox	Superior Court of Washington	King County Washington	8/21/2015 A
14-60528-CV-JIC	Transatlantic Lines Portus Stevedoring	Mechanical and Metallurgical Eng.	P	Patrick Novak Jomathan Cooper	US District Court Southern District	Ft. Lauderdale Div. Florida	8/26/2015 T
2012 CA 023388 XXX MB	Levell & Janie Dixon Actualidad Radio Group	Mechanical	D	Dan Brito Greg Weiser	Circuit Court 15th Judicial Circuit	Palm Beach County Florida	11/13/2015
13-018268-04	Cuellar Courtyards at Davie	Mechanical	D	Joel Roth David Lipkin	Circuit Court 17th Judicial Circuit	Broward County Florida	12/2/2015
14-CA-011105	Bell Harbor Freight Tools	Mechanical	D	Anthony Martino Joseph Varner	Circuit Court 13th Judicial Circuit	Hillsborough County Florida	12/11/2015
CACE-15-002998 (03)	Frank Niagara Industries	Mechanical Engineering	D	Joseph Slama Tom McCausland	Circuit Court 17th Judicial Circuit	Broward County Florida	12/21/2015
2013CA 017899	Arellano Home Depot	Mechanical Engineering	D	William Zoeller Anthony Merendino	Circuit Court 15th Judicial Circuit	Palm Beach County Florida	2/11/2016
2:15-cv-00805-RGK-FFM	CMI Integrated Tech. Xzeres Corp.	Mechanical Engineering	D	Michael Montgomery Amy Furness	U.S. District Court	Central District of CA Western Division	2/16/2016
2:15-cv-00805-RGK-FFM	CMI Integrated Tech. Xzeres Corp.	Mechanical Engineering	D	Michael Montgomery Mark Neubauer	U.S. District Court	Central District of CA Western Division	2/24 & 2/25/2016 T
14-CA-011105	John Bell Harbor Freight Tools	Materials Engineering	D	Anthony Martino Joseph Varner	Circuit Court 13th Judicial Circuit	Hillsborough County Florida	5/5/2016 H

CASE #	LITIGANTS	SUBJECT OF TESTIMONY	P or D	COUNSEL	JURISDICTION	VENUE	DATE OF TESTIMONY
2:14-cv-12488	Weber Manufacturing Plasan Carbon Composites	Mechanical Engineering	P	Doron Yitzchaki Stephen Dunn	U.S. District Court	Eastern District of MI Southern Division	5/27/2016
5:14-cv-01872-DSF)AFMx)	Goldberg Goss-Jewett Co.	Mechanical Engineering	P	Bret Stone Christopher Johnson	U.S. District Court	Central District California	6/1/2016
2012 CA 023388 XXX MB	Levell & Janie Dixon Actualidad Radio Group	Mechanical	 D	Dan Brito Greg Weiser	Circuit Court 15th Judicial Circuit	Palm Beach County Florida	7/21/2016 T
02-15-0002-9635	GE Transportation Ellwood National Crankshaft	Metallurgical and Mechanical Engineering	P	John Scalzo Fridrikh Shrayber	American Aribtration Association	Pittsburgh Pennsylvania	10/6/2016
01-14-0002-1826	Toshiba Intl. Kingsbury, Inc.	Mechanical Engineering	P	Gene Weisberg Francis S. Floyd	American Aribtration Association	San Francisco California	11/21/2016
01-14-0002-1826	Toshiba Intl. Kingsbury, Inc.	Mechanical Engineering	P	Gene Weisberg Francis S. Floyd	American Aribtration Association	San Francisco California	12/6 & 12/7/2016 A
01-15-004-9938	GE Transportation Consolidated Precision Products	Metallurgical and Mechanical Engineering	P	John Scalzo Brian Rose	American Arbitration Assoc. Int'l Centre for Dispute Resol.	Cleveland, OH	4/24/2017
3:15-13328	Sigman, et al. CSX Transportation Sperry Rail Service	Metallurgical Engineering	 D D	D. Blayne Honeycutt Robert Massie John D. "Jack" Hoblitzell, III	U.S. District Court	Southern District of West Virginia Huntington Division	2/2/2018
CV-2017-900038	Pettway Vac-Con, Inc., et al.	Materials Engineering	 D	Robert Mitchell Michael Truncale	Circuit Court	Mobile County Alabama	2/19/2018
2012-CA-011871-O	Rutledge Probus Online, Inc.	Mechanical Engineering	P	W. Andrew Rariden Michael J. Merrill	Circuit Court 9th Judicial Circuit	Orange County Florida	4/5/2018
2016-03483	Sandbox Logistics Arrows Up, Inc	Materials Engineering Mechanical and	 D	Matthew P. Whitley Stephen Loftin	Texas State Court 334th Judicial District	Harris County Texas	4/18/2018
8:16-CV-1241-T-17JSS	Lidey Luehrs' Ideal Rides, Inc.	Mechanical Engineering	 D	Jonathan D. Rubinstein James R. Brown	U.S. District Court	Middle District of Florida Tampa Division	6/6/2018
2016-03483	Sandbox Logistics Arrows Up, Inc.	Mechanical and Materials Engineering	 D	Matthew P. Whitley Stephen Loftin	Texas State Court 334th Judicial District	Harris County Texas	6/28/2018 T
16-02709-MD-W-GAF	Browning Dollar General Corp.	Mechanical and Metallurgical Engineering	 D	Ryan Casey R. Trent Taylor	U.S. District Court	Western District of Missouri Missouri	7/18/2018

CASE #	LITIGANTS	SUBJECT OF TESTIMONY	P or D	COUNSEL	JURISDICTION	VENUE	DATE OF TESTIMONY
2012-CA-011871-O	Rutledge Central Florida Injury Probus Online	Mechanical Engineering	P	Andy Rariden Ronald Harrop Michael Merrill	Florida State Court Ninth Judicial Circuit	Orange County Florida	10/23/2018 T
BC 646594	Mamdouh Habib RR Street	Mechanical Engineering	D	Raphael Metzger John Thomas	California Superior Court Los Angeles Central District	Los Angeles, CA	6/20/2019
18-009614	Akif Ali GeoVera Specialty Insurance	Metallurgical Engineering	D	Geoffrey Gilbert Karen Brimmer	Circuit Court 17th Judicial Dstrt Broward County, FL	Broward County, FL	8/23/2019
2017-025835-CA-01	D Miami Investment Inc. NCH Pumbing, Inc.	Mechanical Engineering Materials Engineering	D	Natasha Rivera Alexander Alvarez	Circuit Court 11th Circuit Miami-Dade County, FL	Miami, FL	9/6/2019

Exhibit D

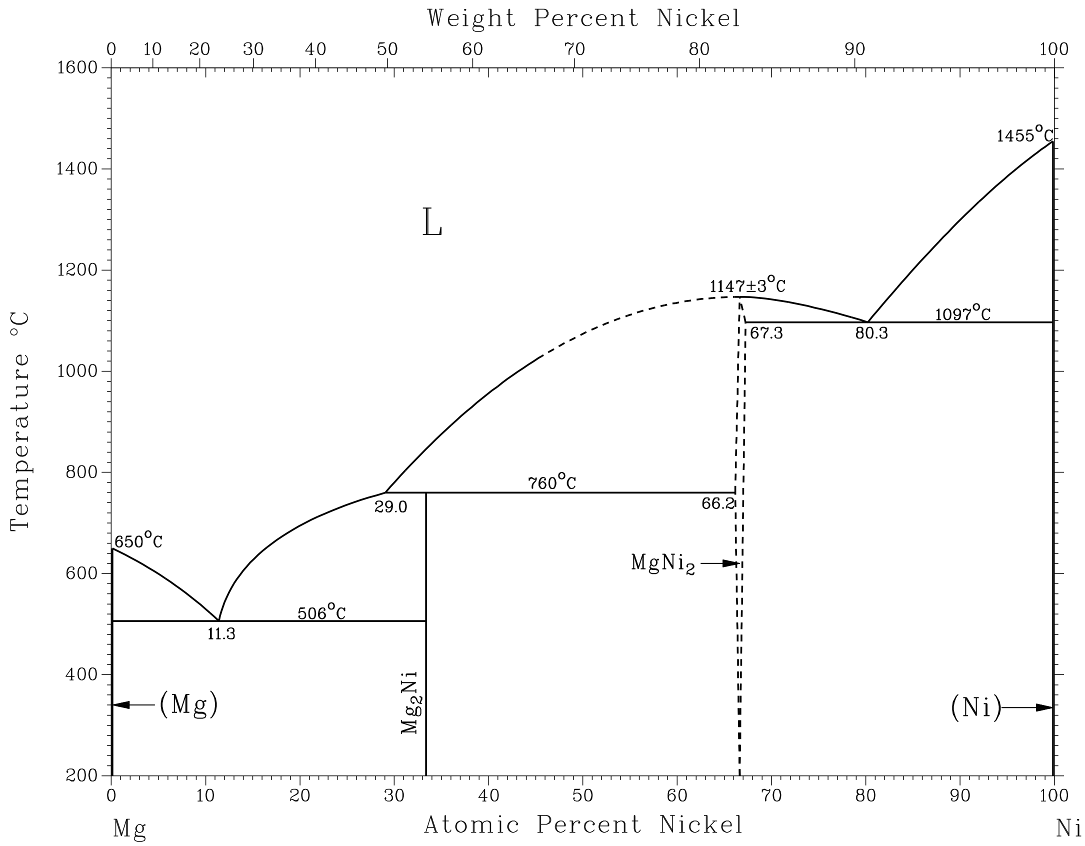

Exhibit D-1. Mg-Ni binary phase diagram. (ASM-International)

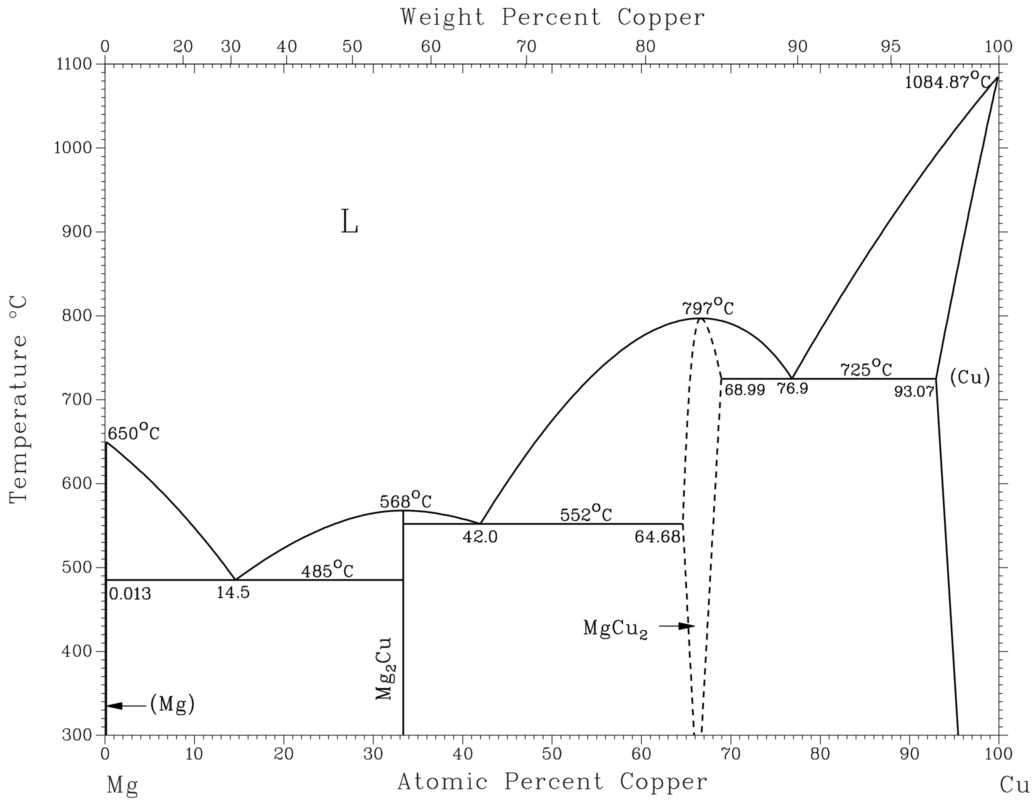

Exhibit D-2. Mg-Cu binary phase diagram. (ASM-International)

Exhibit E

Exhibit E: Reference Texts w Definitions:

Intermetallic Phase or Compound

Metals Handbook Desk Edition, Boyer, Howard E. and Timothy L. Gall, ASM, 1985, Pg. 1-22:

intermediate phase. In an alloy or a chemical system, a distinguishable homogeneous phase whose composition range does not extend to any of the pure components of the system.

intermetallic compound. An intermediate phase in an alloy system, having a narrow range of homogeneity and relatively simple stoichiometric proportions; the nature of the atomic binding can be of various types, ranging from metallic to ionic.

Theoretical Structural Metallurgy, Cottrell, A. H., Edward Arnald (Publishers) Ltd. 1965, Pg. 126:

widely according to the factors determining the attraction. When formed from true metals the structure is usually an *ordered solid solution* or *superlattice*. When the components differ electrochemically from one another the bonds between their atoms become partly of *ionic* type (see section 1.7) and in many such cases the structure is termed an *intermetallic compound*. In the extreme case where the added component is a strongly electronegative non-metal, e.g. sulphur, oxygen, chlorine, a true chemical compound is formed and the material no longer possesses the metallic qualities of an alloy.

Phase Diagrams in Metallurgy, Their Development and Application, Rhines, Frederick N., McGraw-Hill Book Company, 1956, pg. 78:

The *intermediate phases*, which are those that are not isomorphous with either of the components of the alloy system (i.e., they occur between the terminal phases), are often classified in two groups according to whether they are congruently melting or incongruently melting. The incongruently melting intermediate phases will be considered in succeeding chapters, where the peritectic, peritectoid (incongruently transforming), and syntectic reactions are discussed. For the moment, attention will be centered upon the congruently melting phases. These are sometimes referred to as *intermetallic compounds*. Although the use of this term is well justified in some instances upon the ground that a specific intermediate phase occurs at a composition corresponding to a simple ratio of the two kinds of atoms concerned, there are so many apparent exceptions that it seems better, on the whole, to regard all such phases simply as "intermediate phases" and to designate them by the use of Greek letters instead of molecular symbols. This practice has been adopted with increasing regularity in recent years by authors of phase diagrams:

Foundations of Material Science and Engineering, Smith, William F. & Javad Hashemi, McGraw-Hill Higher Education, 2006, pgs 343 & 344.

If the intermediate compound is formed between two metals, the resulting material is a crystalline material called an *intermetallic compound* or simply an *intermetallic*. Generally speaking, the intermetallic compounds should have a distinct chemical formula or be stoichiometric (fixed ratio of involved atoms). However, in

many cases a certain degree of atomic substitution takes place that accommodates large deviations from stoichiometry. In a phase diagram intermetallics appear either as a single vertical line, signifying the stoichiometric nature of the compound (see $TiNi_3$ line in Fig. EP8.8), or sometimes as a range of composition, signifying a non-stoichiometric compound (for example, the substitution of Cu for Zn or Zn for Cu atoms in the β and γ phases of the Cu-Zn phase diagram shown in Fig. 8.27). The majority of the intermetallic compounds possess a mixture of metallic-ionic or metallic-covalent bonds. The percentage of ionic or covalent bonds formed in intermetallic compounds depends on the differences in the electronegativities of the elements involved (see Sec. 2.9).

Structure and Properties of Engineering Materials, Fifth Edition, Henkel, Daniel & Alan W. Pense, McGraw Hill, 2002, pg. 114:

5.2 INTERMETALLIC COMPOUNDS

In the previous eutectic phase diagrams, there are two terminal solid solutions separated by a two-phase field. Often, however, intermediate phases occur in the phase diagram. These are crystallographically different structures whose composition can vary over certain limits. Sometimes intermediate phases exist over only a very small range of compositions. In this case they are called intermetallic compounds—compounds because they have a sharp melting point (or decomposition point, namely, peritectics) and other characteristics of distinct chemical species and because they often have compositions that are simple ratios when expressed as atom fractions. These compounds can be one constituent in eutectics. For example, the

Material Science and Engineering, An Introduction, Sixth Edition, Callister, William D. Jr., John Wiley & Sons, Inc., 2003, Pg. 782.

Intermetallic compound. A compound of two metals that has a distinct chemical formula. On a phase diagram it appears as an intermediate phase that exists over a very narrow range of compositions.

Melting Point or Melting Temperature

Metals Handbook Desk Edition, Boyer, Howard E. and Timothy L. Gall, ASM, 1985, pg. 1-25:

melting point. The temperature at which a pure metal, compound or eutectic changes from solid to liquid; the temperature at which the liquid and the solid are in equilibrium.

McGraw-Hill Dictionary of Scientific and Technical Terms, Third Edition, 1984, pg. 993:

melting point [THERMO] **1.** The temperature at which a solid of a pure substance changes to a liquid. Abbreviated mp. **2.** For a solution of two or more components, the temperature at which the first trace of liquid appears as the solution is heated.

Quantitative Metallurgy

Metals Handbook Desk Edition, Boyer, Howard E. and Timothy L. Gall, ASM, 1985, pg. 1-30:

quantitative metallography. Determination of specific characteristics of a microstructure by making quantitative measurements on micrographs or metallographic images. Quantities so measured include volume concentration of phases, grain size, particle size, mean free path between like particles or secondary phases, and surface-area-to-volume ratios of microconstituents, particles or grains.